

8/19/03

L11 ANSWER 1 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB The wafers are manufd. by mixing Ga with Si raw materials and pulling up Si **single crystals** under conditions where whole surfaces of crystals in the diam. direction are N-regions, V-rich regions, or their mixed regions. The wafers are useful for **solar cells**. The obtained wafers show no formation of oxidn.-induced stacking faults and dislocation clusters.

ACCESSION NUMBER: 2002:422903 CAPLUS

DOCUMENT NUMBER: 137:13592

TITLE: Gallium-doped silicon **single crystal** wafers and their manufacture by **Czochralski** method

INVENTOR(S): Oki, Konomu

PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.

SOURCE: Jpn. Kokai Tokkyo Koho, 8 pp.

CODEN: JKXXAF

DOCUMENT TYPE: Patent

LANGUAGE: Japanese

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002160995	A2	20020604	JP 2000-359299	20001127
PRIORITY APPLN. INFO.:			JP 2000-359299	20001127

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L11 ANSWER 1 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

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JP 2002160995	A2	20020604	JP 2000-359299	20001127
PRIORITY APPLN. INFO.:			JP 2000-359299	20001127

L11 ANSWER 2 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB The title Si crystal is doped with Ga and P. A **single crystal** is manufd. by **Czochralski** method from a Si melt added with Ga and P. Alternatively, a polycrystal is manufd. by Bridgman method from the melt. Also claimed is a wafer obtained by slicing the crystal. The wafer, esp. suitable for **solar cells**, is

manufd. at low cost and has high conversion efficiency.

ACCESSION NUMBER: 2002:264795 CAPLUS  
DOCUMENT NUMBER: 136:282010  
TITLE: Doped silicon crystal, its wafer, and manufacture of the crystal for **solar cell**  
INVENTOR(S): Fujimaki, Nobuyoshi  
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.  
SOURCE: Jpn. Kokai Tokkyo Koho, 10 pp.  
CODEN: JKXXAF  
DOCUMENT TYPE: Patent  
LANGUAGE: Japanese  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002104898	A2	20020410	JP 2000-296022	20000928
PRIORITY APPLN. INFO.:			JP 2000-296022	20000928

L11 ANSWER 3 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
AB The title Si crystal is doped with Ga and B. A **single crystal** is manufd. by **Czochralski** method from a Si melt added with Ga and B. Alternatively, a polycrystal is manufd. by Bridgman method from the melt. Also claimed is a wafer obtained by slicing the crystal. The wafer, esp. suitable for **solar cells**, is manufd. at low cost and has high conversion efficiency.

ACCESSION NUMBER: 2002:264793 CAPLUS  
DOCUMENT NUMBER: 136:282009  
TITLE: Doped silicon crystal, its wafer, and manufacture of the crystal for **solar cell**  
INVENTOR(S): Fujimaki, Nobuyoshi  
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.  
SOURCE: Jpn. Kokai Tokkyo Koho, 10 pp.  
CODEN: JKXXAF  
DOCUMENT TYPE: Patent  
LANGUAGE: Japanese  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002104897	A2	20020410	JP 2000-292087	20000926
PRIORITY APPLN. INFO.:			JP 2000-292087	20000926

L11 ANSWER 4 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
AB The **solar cell** has B and Ga dopants in a **single crystal** Si substrate. The **solar cell** is manufd. by drawing a **single crystal** B doped Si by the **Czochralski** method, prepg. a substrate from the **single crystal**, and diffusing Ga in the substrate.

ACCESSION NUMBER: 2002:220055 CAPLUS  
DOCUMENT NUMBER: 136:234788  
TITLE: **Solar cell** and its manufacture  
INVENTOR(S): Kume, Fumitaka  
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.  
SOURCE: Jpn. Kokai Tokkyo Koho, 7 pp.  
CODEN: JKXXAF  
DOCUMENT TYPE: Patent  
LANGUAGE: Japanese  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002083981	A2	20020322	JP 2000-271420	20000907
PRIORITY APPLN. INFO.:			JP 2000-271420	20000907

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AB A Ga-doped Si **single crystal** is manufd. by **Czochralski** method, wherein Al of amt. less than that of Ga is also added during the crystal growth. The manufd. Ga-doped Si **single crystal** is claimed. The Ga concn. may be (3 .times. 10<sup>15</sup>)-(5 .times. 10<sup>17</sup>) atoms/cm<sup>3</sup>. A **solar cell** employing the Si **single crystal** is also claimed. The crystal inhibits generation of heavy metal-derived OSF (oxidn.-induced stacking fault), so that the **solar cell** provides high and durable photoelec. conversion efficiency.

ACCESSION NUMBER: 2002:113783 CAPLUS

DOCUMENT NUMBER: 136:159187

TITLE: Gallium-doped silicon **single crystal** and its manufacture by **Czochralski** method, and silicon **single crystal solar cell**

INVENTOR(S): Tsuda, Nobuhiro

PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.

SOURCE: Jpn. Kokai Tokkyo Koho, 8 pp.

CODEN: JKXXAF

DOCUMENT TYPE: Patent

LANGUAGE: Japanese

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002047095	A2	20020212	JP 2000-231535	20000731
PRIORITY APPLN. INFO.:			JP 2000-231535	20000731

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AB Ga-doped Si **single crystal** is manufd. from Si raw material contained in a crucible with 2-2.5 times diam. of the diam. of the manufg. **single crystal**. Thus manufd. crystal is also claimed. Ga-doped Si **single crystals** showing high energy efficiency when used in **solar cells** are manufd. at high pulling rate at low cost.

ACCESSION NUMBER: 2002:63422 CAPLUS

DOCUMENT NUMBER: 136:110345

TITLE: Ga-doped silicon **single crystals** and their manufacture by **Czochralski** process

INVENTOR(S): Oki, Yoshi; Iida, Makoto

PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.

SOURCE: Jpn. Kokai Tokkyo Koho, 8 pp.

CODEN: JKXXAF

DOCUMENT TYPE: Patent

LANGUAGE: Japanese

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002020192	A2	20020123	JP 2000-196706	20000629
PRIORITY APPLN. INFO.:			JP 2000-196706	20000629

L11 ANSWER 7 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB This paper reports high-efficiency PERT (passivated emitter, rear totally-diffused) **solar cells** fabricated on a variety of **single cryst.** silicon substrates. The best cell efficiencies achieved are 21.9, 24.5, and 24.0% for Ga-doped **Czochralski** Si, B-doped magnetically confined **Czochralski** Si, and B-doped float-zone Si substrates, resp. The performance of all these cells is stable after illumination under 1-sun level. This is a result of avoiding using both high levels of boron and oxygen in the same material as occurs in B-doped **Czochralski** silicon **solar cells**, where large performance degrdn. is commonly obsd.

ACCESSION NUMBER: 2001:539756 CAPLUS  
DOCUMENT NUMBER: 135:291253  
TITLE: High efficiency PERT cells on a variety of **single crystalline** silicon substrates  
AUTHOR(S): Zhao, Jianhua; Wang, Aihua; Green, Martin A.  
CORPORATE SOURCE: Centre for Photovoltaic Engineering, University of New South Wales, Sydney, NSW 2052, Australia  
SOURCE: European Photovoltaic Solar Energy Conference, Proceedings of the International Conference, 16th, Glasgow, United Kingdom, May 1-5, 2000 (2000), Volume 2, 1100-1103. Editor(s): Scheer, Hermann. James & James (Science Publishers) Ltd.: London, UK.  
CODEN: 69BOEK  
DOCUMENT TYPE: Conference  
LANGUAGE: English  
REFERENCE COUNT: 6 THERE ARE 6 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L11 ANSWER 8 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB A Si **single crystal** which is produced by **Czochralski** method and added with Ga as a dopant is characterized as having a resistivity of 5 .OMEGA..bul.cm to 0.1 .OMEGA..bul.cm; a wafer manufd. from the Si **single crystal**; and a method for producing a Si **single crystal** doped with Ga by **Czochralski** method are characterized in that the method comprises adding Ga to a Si melt in a crucible and then bringing the Si melt into contact with a seed crystal, and pulling up the seed crystal while rotating it, to thereby prep. a Si **single crystal** rod. The Si **single crystal**, although it has a high O concn. like a conventional Si **single crystal** by CZ method, can be used for manufg. a **solar cell** which is free from the deterioration caused by light and exhibits very high efficiency for the conversion of light energy.

ACCESSION NUMBER: 2000:861876 CAPLUS  
DOCUMENT NUMBER: 134:11717  
TITLE: Cz **single crystal** doped with Ga and wafer and method for production thereof  
INVENTOR(S): Abe, Takao; Hirasawa, Teruhiko; Tokunaga, Katsushi; Igarashi, Tetsuya; Yamaguchi, Masafumi  
PATENT ASSIGNEE(S): Shin-Etsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Co., Ltd.  
SOURCE: PCT Int. Appl., 38 pp.  
CODEN: PIXXD2  
DOCUMENT TYPE: Patent  
LANGUAGE: Japanese  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2000073542	A1	20001207	WO 2000-JP2850	20000428
W: AU, JP, KR, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL,				

PT, SE  
EP 1114885 A1 20010711 EP 2000-922915 20000428  
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT,  
IE, FI  
PRIORITY APPLN. INFO.: JP 1999-150697 A 19990528  
JP 1999-264549 A 19990917  
WO 2000-JP2850 W 20000428

REFERENCE COUNT: 13 THERE ARE 13 CITED REFERENCES AVAILABLE FOR THIS  
RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L11 ANSWER 9 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
AB Observations on deep levels introduced in silicon by 1 MeV electron  
irradn. are reported using boron- or **gallium**-doped  
**Czochralski** (CZ) grown Si space **solar cells**  
with different doping concns., deep level transient spectroscopy anal. has  
been carried out to detect the radiation-induced deep levels. Present  
results provide evidence for new defect states in addn. to those  
previously reported in **gallium**- and boron-doped Si. The  
combined boron and **gallium** data provide enough information to  
gain valuable insight into the role of the dopants on radiation induced  
defects in Si. The dominant donor-like electron level at EC-0.18 eV in  
boron-doped Si has not been obsd. in **gallium**-doped CZ-grown Si.  
A noticeable suppressing generation of the radiation-induced defects in  
**gallium**-doped Si is also obsd., esp. hole level EV+0.36 eV, which  
is thought to acts as a recombination center.

ACCESSION NUMBER: 2000:371176 CAPLUS  
DOCUMENT NUMBER: 133:113054  
TITLE: Influence of the dopant species on radiation-induced  
defects in Si **single crystals**  
AUTHOR(S): Khan, Aurangzeb; Yamaguchi, Masafumi; Kaneiwa, Minoru;  
Saga, Tatsue; Abe, Takao; Annzawa, Osamu; Matsuda,  
Sumio  
CORPORATE SOURCE: Toyota Technological Institute, Tempaku, Nagoya,  
468-8511, Japan  
SOURCE: Journal of Applied Physics (2000), 87(12), 8389-8392  
CODEN: JAPIAU; ISSN: 0021-8979  
PUBLISHER: American Institute of Physics  
DOCUMENT TYPE: Journal  
LANGUAGE: English  
REFERENCE COUNT: 14 THERE ARE 14 CITED REFERENCES AVAILABLE FOR THIS  
RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L11 ANSWER 10 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
AB A simple, vertical-dipping, liq.-phase epitaxy (LPE) method for growth of  
Si layers from Cu/Si soln. at temps. less than 950.degree. has been shown  
to be a promising technique for thin cryst. Si photovoltaic (PV)  
applications. **Solar cells** with more than 15% AM1  
efficiency were fabricated on 5-.mu.m-thick layers grown from Cu/Si soln.  
on (111) **Czochralski** (CZ) substrates. To extend the application  
of this technique to low-cost substrates, we grew thin (5-40 .mu.m) Si  
layers on cast multicryst. metallurgical-grade (MG) substrates from Cu/Si  
soln. as well as from Al/Si, Al/Cu/Si, Bi/Si, Ga/Cu/Si, and Sn/Si solns.  
The conditions of growth, morphol., solvent incorporation characteristics  
and problems that arise with the use of multicryst. Si substrates are  
discussed. A diagnostic **solar cell** with efficiency  
equal to 0.42 and open-circuit voltage equal to 0.89 of the values for a  
**single crystal** control cell was obtained, without any  
light-trapping scheme, on a 15-.mu.m-thick layer grown on a MG Si  
substrate.

ACCESSION NUMBER: 1995:75199 CAPLUS  
DOCUMENT NUMBER: 122:218427  
TITLE: Si thin layer growth from metal solutions on  
**single-crystal** and cast  
metallurgical-grade multicrystalline Si substrates

AUTHOR(S): Ciszek, T. F.; Wang, T. H.; Wu, X.; Burrows, R. W.;  
Alleman, J.; Schwerdtfeger, C. R.; Bekkedahl, T.  
CORPORATE SOURCE: National Renewable Energy Laboratory, Golden, CO,  
80401, USA  
SOURCE: Conference Record of the IEEE Photovoltaic Specialists  
Conference (1993), 23rd, 65-72  
CODEN: CRCNDP; ISSN: 0160-8371  
DOCUMENT TYPE: Journal  
LANGUAGE: English

L11 ANSWER 11 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB A review with 157 refs. The established technologies of Si, CdS/Cu<sub>2</sub>S, and GaAs cells are examd. in terms of manufg. processes, advantages, disadvantages, efficiencies, applications, and further reading. Several emerging technologies are then treated including the heat-exchange method, the edge-defined film-fed growth ribbon process, the dendritic web growth process, advanced **Czochralski** processes, alternative methods of fabricating cells from **single-crystal** Si such as ion implantation and metal-insulator-semiconductor junctions, polycryst. Si cells, amorphous Si cells, CdS/CuInSe<sub>2</sub> cells, GaAs cells, and photoelectrochem. cells. Advanced concepts such as multijunction cells, emerging semiconductor materials, and org. cells are treated. Concentrator systems and cells designed specifically for high light levels are analyzed and assessed as to com. viability.

ACCESSION NUMBER: 1983:615620 CAPLUS  
DOCUMENT NUMBER: 99:215620  
TITLE: **Solar cells** - a technology  
assessment

AUTHOR(S): Bolton, James R.  
CORPORATE SOURCE: Dep. Chem., Univ. West. Ontario, London, ON, N6A 5B7,  
Can.  
SOURCE: Solar Energy (1983), 31(5), 483-502  
CODEN: SRENA4; ISSN: 0038-092X  
DOCUMENT TYPE: Journal; General Review  
LANGUAGE: English

L11 ANSWER 12 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB A method is described for cheaply growing **single-crystal** sheets with duplicate surface textures from polycryst. or amorphous Ge, Si, and GaAs for **solar cells** and CdTe and (Hg,Cd)Te for IR detectors. A **single-crystal** wafer is 1st texture etched to a depth of 0.5-10 .mu., a stratum of a release compn. (Al, Ni, Mo, W, C, Ti, and their alloys and compds.) is deposited by vapor deposition to a depth of 0.1-10 .mu., a metal or glass support is attached to the release stratum to provide mech. strength, the release stratum is sepd. from the wafer by raising the temp. and inverted to form a replica master, a replica stratum of amorphous or polycryst. structure is deposited on the replica master to a depth of .apprx.1 .mu., the replica stratum is grown into a **single-crystal** layer by pulsed irradiation (laser or electron beam) in a master scan, and the crystal layer is sepd. for use. The replica master can be reused or used to produce other replica masters. Thus, a **Czochralski**-grown Si (100) wafer was etched with KOH to a depth of 2 .mu., an .apprx.10-.mu. thick Al release stratum was deposited by evapn., a support of 1/8-in. thick borosilicate glass was electrostatically bonded to the Al, the temp. was raised to 250 .degree.F to release the Al, amorphous Si was deposited on the Al by chem. vapor deposition, the amorphous Si was irradiated with a 12-keV pulsed electron beam and transformed to a **single crystal**, several other layers of amorphous Si were deposited and irradiated until a **single crystal** 10-30 .mu. thick was formed, and the new Si wafer was sepd. and formed into a p-n junction **solar cell** by ion implantation.

ACCESSION NUMBER: 1982:606179 CAPLUS  
DOCUMENT NUMBER: 97:206179

TITLE: Single crystal processes and products  
 INVENTOR(S): Little, Roger G.  
 PATENT ASSIGNEE(S): Spire Corp., USA  
 SOURCE: U.S., 7 pp.  
 CODEN: USXXAM  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 4350561	A	19820921	US 1980-150331	19800516
PRIORITY APPLN. INFO.:			US 1980-150331	19800516

L11 ANSWER 13 OF 13 INSPEC (C) 2003 IEE on STN  
 AN 2000:6612530 INSPEC DN A2000-14-7155-008; B2000-07-2520C-023  
 AB Observations on deep levels introduced in **silicon** by 1 MeV electron irradiation are reported using boron- or **gallium**-doped **Czochralski** (CZ) grown Si space solar cells with different doping concentrations, deep level transient spectroscopy analysis has been carried out to detect the radiation-induced deep levels. Present results provide evidence for new defect states in addition to those previously reported in **gallium**- and boron-doped Si. The combined boron and **gallium** data provide enough information to gain valuable insight into the role of the dopants on radiation induced defects in Si. The dominant donor-like electron level at EC-0.18 eV in boron-doped Si has not been observed in **gallium**-doped CZ-grown Si. A noticeable suppressing generation of the radiation-induced defects in **gallium**-doped Si is also observed, especially hole level EV+0.36 eV, which is thought to acts as a recombination center.

DOCUMENT NUMBER: A2000-14-7155-008; B2000-07-2520C-023  
 TITLE: Influence of the dopant species on radiation-induced defects in Si **single crystals**.  
 AUTHOR: Khan, A.; Yamaguchi, M. (Toyota Technol. Inst., Nagoya, Japan); Kaneiwa, M.; Saga, T.; Abe, T.; Annzawa, O.; Matsuda, S.  
 SOURCE: Journal of Applied Physics (15 June 2000) vol.87, no.12, p.8389-92. 14 refs.  
 Doc. No.: S0021-8979(00)05212-9  
 Published by: AIP  
 Price: CCCC 0021-8979/2000/87(12)/8389(4)/\$17.00  
 CODEN: JAPIAU ISSN: 0021-8979  
 SICI: 0021-8979(20000615)87:12L:8389:IDSR;1-V  
 DOCUMENT TYPE: Journal  
 TREATMENT CODE: Practical; Experimental  
 COUNTRY: United States  
 LANGUAGE: English

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L13 ANSWER 30 OF 32 CAPLUS COPYRIGHT 2002 ACS  
 AN 1985:223339 CAPLUS  
 DN 102:223339  
 TI Irradiated **solar cells** fabricated from **gallium**  
 -doped/boron-doped FZ and CZ **silicon**  
 AU Minahan, Joseph A.; Neal, N.; Dionne, D.; Taylor, William E.; Trumble,  
 Terry M.  
 CS Spectrolab, Inc., Sylmar, CA, 91342, USA  
 SO Conf. Rec. IEEE Photovoltaic Spec. Conf. (1982), 16th, 310-15  
 CODEN: CRCNDP; ISSN: 0160-8371  
 DT Journal  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 AB The tolerance to various fluence levels of 1-MeV electrons of  
**solar cells** fabricated from Ga- and B-doped multipass FZ  
 (float-zone) Si, and Ga- and B-doped crucible-grown (CZ) Si was compared.  
 The FZ materials used for the study were of ultrahigh purity with low  
 levels of O and C. Bulk anal. of Ga-doped CZ Si is included and compared  
 with Ga-doped FZ Si. Bulk anal. of selected wafers in the various  
**crystals** was performed by low-temp. Fourier-transform IR and  
 surface photovoltage. Measurement of air-mass-0 elec. characteristics and  
 spectral response of **solar cells** fabricated from these  
 Si materials before and after 1-MeV electron irradiation are used to compare  
 radiation tolerance of the materials.  
 ST electron irradiation silicon **solar cell**; **gallium**  
**doped silicon solar cell**; boron  
**doped silicon solar cell**  
 IT Electron beam, chemical and physical effects  
 (on boron- and **gallium-doped silicon**  
**solar cells**)  
 IT Photoelectric devices, solar  
 (**silicon**, boron- and **gallium-doped**  
 float-zone and crucible-grown, electron irradiation of)  
 IT 7440-42-8, uses and miscellaneous 7440-55-3, uses and miscellaneous  
 RL: USES (Uses)  
 (photoelec. **solar cells** from silicon doped with,  
 float-zone and crucible-grown, electron irradiation of)  
 IT 7440-21-3, uses and miscellaneous  
 RL: USES (Uses)  
 (photoelec. **solar cells**, boron- and gallium-doped  
 float-zone and crucible-grown, electron irradiation of)